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Status report for northern Labrador Arctic charr stocks in 1993

by

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Abstract

Catch and effort statistics for the northern Labrador Arctic charr fishery in 1993 are summarized. Total northern Labrador charr landings of 38 t were the lowest on record since 1974 and 66% below the previous 10-year mean of 112 t. Charr landings from the Nain fishing region totaled 34 t or 88% of the northern Labrador catch. Within the Nain fishing region, effort among all stock units was similarly the lowest recorded. Catch rates in all stock units were generally low, but lower values have occurred in previous years. Landings of Arctic charr in the Nain assessment unit during 1993 represented 40% of the overall catch from the Nain fishing region, while the Voisey unit contributed 25%. Charr landings from the Hebron and Saglek fiord subareas contributed 26% of the Nain region catch. Information on timing of the fisheries, catch- and weight-at-age along with an index of condition are provided for the three main stock units to complement previous studies. Some comments from local fisherpersons are also included.

Résumé

On présente un sommaire des statistiques sur les prises et l'effort de pêche de l'omble chevalier dans le nord du Labrador en 1993. Les débarquements totaux pour cette région, soit 38 t, sont les plus bas enregistrés depuis 1974 et sont inférieurs de 66 % à la moyenne des dix dernières années (112 t). Les débarquements d'omble chevalier provenant de la zone de pêche de Nain s'établissaient à 34 t, ce qui représente 88 % des prises de tout le nord du Labrador. Dans la zone de Nain, l'effort dans toutes les unités de stock était le plus bas enregistré à ce jour. Les taux de prises étaient généralement faibles dans toutes les unités de stock, mais on en a connu de plus bas antérieurement. En 1993, les débarquements d'omble chevalier de l'unité d'évaluation de la baie de Nain représentaient 40 % des prises totales de la zone de pêche de Nain, tandis que celles de l'unité d'évaluation de Voisey représentaient 25 % du total. Les débarquements d'omble chevalier provenant des secteurs des fjords Hebron et Saglek constituaient 26 % des prises de la zone de pêche de Nain. Pour compléter les études antérieures, on présente également des renseignements au sujet de la période à laquelle se déroule la pêche, des prises et du poids selon l'âge, ainsi qu'un index des conditions dans les trois principales unités de stock. Sont aussi incluses les observations de certains pêcheurs de la région.

Introduction

Continuous records of commercial landings of anadromous Arctic charr (Salvelinus alpinus) from the northern Labrador coast are available since 1944. Catch statistics from the Nain and Makkovik Fishing Regions, and from subareas within the Nain Fishing Region (Fig. 1) exist since 1974. From 1977 to 1982 more than 200 t per year of Arctic charr were caught in northern Labrador but during the previous five years (1988-92) annual landings averaged only 87 t. The highest landings on record were 252 t in 1981. The lowest landings during the past 30 years were 38 t and occurred in the most recent year, 1993. Much of the decline in landings in the Nain fishing region during the past eight years can be attributed to a reduction in fishing effort. However, recent assessments of the Voisey and Nain stock units have also indicated that current stock sizes were below levels estimated for the late 1970's and early 1980's (Dempson 1992, 1993a). Recently, the Labrador Inuit Association (LIA) has explored the feasibility of developing in-river fisheries for Arctic charr in some of the northern fiord subareas. These fisheries could provide selective harvests on some charr stocks while at the same time providing an opportunity for a direct evidence of actual spawning escapements.

This paper summarizes catch statistics information for the 1993 northern Labrador Arctic charr fishery and updates previous reports (summarized in Dempson and Shears 1991, 1992, and Dempson 1993a) which have examined landings in the commercial fishery.

Methods

Information on commercial landings of Arctic charr from the Nain fishing region was obtained through purchase slips prepared by Fisheries Statistics and Systems Branch of the Department of Fisheries and Oceans and processed by Salmon and Charr Section of the Salmonid and Habitat Sciences Division. Information on landings from the Makkovik region were obtained directly from records provided by the Makkovik fish plant. Purchase slips from the Nain fishing region included the following information: name of the fisherperson, licence number, area where the fish were caught, date, weight of fish (by species) landed, and number of fish caught. Landed gutted head-on catches were converted to round weight (in kilograms) using the conversion factor: gutted head-on weight x 1.22 = round weight (Dempson 1984). Catch per unit effort estimates in this document, expressed in terms of kilograms per person-week fished, follow the traditional values used in past reports and were derived from the method initiated by Coady and Best (1976). These unstandardized values are included for comparative purposes with past reports.

A multiplicative model (Gavaris 1980) was used to standardize catch rates for each stock unit and account for differences among

years and weeks. For the Nain and Okak stock units, inshore and offshore zones were treated separately. These fisheries are carried out using shore-set surface gill nets, often in traditional fishing berths. The regression of ln catch rate for the period 1977 to 1993 was initially fitted using SAS REG procedures (SAS 1985) to avail of the various diagnostics available. Back-transformed standardized catch rates were subsequently obtained using a bias correction process also run in SAS.

Information on length, weight and age of Arctic charr caught in the commercial fishery was obtained as fish were processed at the Nain Fish Plant. A two-stage stratified sampling program was carried out. Samples are identified from individual subareas which form component parts of stock units (Dempson and Kristofferson 1987).

Analyses of condition were carried out following the general methods of Patterson (1992) and are fully described in Winters and Wheeler (1994). A general linear model ($\log_e$ transformed) was used to examine the response of fish weight, standardized to a common length, to various factors as:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + b \bullet Z_{ijk} + \epsilon_{ijk}, \quad \text{where}$$

Y_{ijk} = the response variable, charr weight (gutted, head-on), α_i and β_j are class variables month and year, respectively, $(\alpha\beta)_{jk}$ is an interaction term between month and year, Z_{ijk} is the covariate fork length, and ϵ_{ijk} is the error term associated with individual observations. With respect to the month variable, July refers to June and July, while August includes August and September. Charr caught in the commercial fishery are landed in the gutted form. This ensures that stomach fullness and gonadal development, if any, do not confound the interpretation of the overall index of condition. The model was used to calculate adjusted mean weights by year standardized to the covariate. Each stock unit was analysed separately. Analyses followed the sequential procedure described by Winters et al. (1993) and Winters and Wheeler (1994). Initially, analyses were used to determine the appropriate model, i.e., common slope (b) or multiple slope (b_{ijk}). Intercept differences (μ) were tested based on class variable effects if a common slope model was appropriate. Interactions between month and year were examined to investigate the temporal distribution of condition for each stock over a period of 17 years.

Results and Discussion

Total northern Labrador Arctic charr landings

Figure 2 illustrates the commercial landings of Arctic charr from 1944 to 1993. Also shown are the landings from the Nain and Makkovik fishing regions since 1974. During the past 20 years, the Nain region has contributed about 85% of the total northern Labrador catch of Arctic charr averaging 122 t per year. Landings from both regions in 1993 totaled only 38 t, and was 56% and 66% below the previous five (87 t, 1988-92) and ten year (112 t, 1983-92) means (Table 1). Individually, landings in the Nain fishing region of 34 t in 1993 were down 45% from 1992 and 54% and 64% below previous five (72 t, 1988-92) and ten year (94 t, 1983-92) means. The number of people fishing had been relatively consistent during the past few years (1990-92) but dropped considerably in 1993. Effort (unstandardized) in terms of person-weeks fished in 1993 was 28% less than in 1992 and was the lowest value recorded since 1974 (Appendix 1). It has declined by 70% from the 1981-85 average.

Undoubtedly, the extremely poor environmental conditions experienced along the north Labrador coast in 1991 contributed to the decreased effort and general failure of the fishery. Conditions in 1992 were, for the most part, similar to 1991. The 1993 season was also characterized by a late spring. A limited commercial fishery occurred in the Hebron and Saglek fiords in 1993 with landings totaling 9 t and contributing 26% of the Nain region catch of Arctic charr. An experimental in-river fishery slated again for Southwest Brook, Saglek Fiord, did not proceed. In 1992, the experimental fishery at Saglek harvested 2.2 t of charr. This represented 28% of the total number of commercial sized charr (fish > 45 cm) that entered the river during the 18 days of the fishery (August 3-20), but only 4% of the entire run enumerated during that period (N = 31687) (Dempson 1993a).

A summary of harvests from specific experimental river fisheries carried out in the Nain fishing region are provided in Table 2.

Charr landings from the Makkovik region in 1993 decreased by 64% from the previous year and totaled only 5 t. The highest landings in the Makkovik region of 39 t occurred in 1982. Concern has been expressed about low catches and the amount of small charr being caught at Makkovik, Postville, and Hopedale (Unpublished Annual Report by Fishery Officer Eric Andersen, Makkovik, Labrador). Concerns pertain equally to the local food fisheries for charr.

Appendix 1 provides an updated summary of catch and effort statistics for all subareas within the Nain fishing region from 1974 to 1993 (experimental harvests are not included in the

appendix - refer to Table 2). Some of these subareas form component parts of larger assessment or stock units. The Nain fishing region is composed of three primary assessment units (Voisey, Nain, and Okak) in addition to other subareas which are not, at present, component parts of larger assessment units or stock complexes. These primary assessment units have contributed an average of 80% of the commercial production of Arctic charr from the Nain fishing region over the period 1974-91.

Voisey Stock Unit

V.1 Commercial landings and catch rates

The Voisey stock unit is made up of Voisey Bay and the Antons subareas (Fig. 1). Annual landings have ranged from 4 to 41 t (mean = 19 t, 1974-93), and over this interval have contributed 16% of the commercial catch of charr from the Nain fishing region (Table 3). The highest catches occurred during the late 1970's (Fig. 3), the lowest catch of 4 t was in 1975. The Total Allowable Catches (TAC) listed in Table 3 for 1979 to 1984 applied only to the Voisey Bay subarea. The recommended TAC in 1993 was maintained at 14 t.

Landings of Arctic charr from the Voisey assessment unit during 1993 totaled 8.5 t, 60% of the Total Allowable Catch (TAC), and represented 25% of the overall catch from the Nain fishing region during 1993 (Table 3). This was a decline in the stock unit catch of 9% from the previous year. Effort, however, increased by about 23% yielding the lowest unstandardized catch rate on record.

With respect to the standardized catch rates, the regression of ln catch rate for the period 1977-93 explained 48% of the variation in the data. Highest catch rates occurred in the late 1970's, 1983, and again in 1989-90 (Fig. 3). Even in 1992 the catch rate was moderately high. The catch rate in 1993, however, was the third lowest recorded. Generally catch rates are highest during weeks 30-32 (July 23- August 12) in addition to week 25 (June 18-24). Standardized effort has been among the lowest recorded in 1992 and 1993 (Table 4).

V.2 Timing of the fishery

Normally, peak runs of Arctic charr to rivers in the Nain area occur during early August (Dempson and Green 1985). Variability in catches and catch rates must also be considered in the context of run timing to local rivers. This is because some or many fish could potentially not be available for capture depending upon the timing of the commercial fishery. Figure 4 illustrates the timing of the fishery for the Voisey stock unit from 1977-93. The median date of the catch (50^{th} percentile) from 1977-90 was day 199 (July

18). Landings in 1991 were about one week later than this average, but catch timing during the past two years has been similar to the mean.

V.3 Catch at age

Catch at age data are available since 1977 (Table 5). Typically, four age classes (ages 7-10) make up 85% of the catch. Charr are first recruited into the fishery at age 6 and ages over 12 contribute little. The 1985 and 1986 year classes (year of hatching) represented by 7 and 8 year old fish were the most abundant in 1993 contributing 58% of the catch. On a proportional basis, age 6 and 7 fish in 1993 were among the highest represented. Mean age of the catch has ranged from a high of 9.3 years in both 1990 and 1991 to a low of 8.0 years in 1993. In general, mean age of the catch has varied little over time (mean = 8.8 yrs, coefficient of variation (CV) = 4.1%).

Analytical sequential population analyses were not carried out on the most recent data. As noted above, effort during the past several years has been among the lowest recorded and thus there is little basis for an adequate catch rate series from which to calibrate the sequential population analyses.

V.4 Size at age and condition

Weights at age were derived from length-weight relationships obtained from sampling the commercial fishery as explained in past years (Dempson 1990). A comparison of the recorded total landings for 1993 with the cross product total (sum of the matrix of estimated numbers at age x matrix of weights at age) agreed quite well with the discrepancy between the two of about 0.3%. As identified in previous years, weights at age have declined over time (Table 6). Part of the reason for the overall decline in mean weight in 1993 relates to the high proportion of age 6 and 7 fish (44%) in the catch in comparison with previous years.

Analysis of condition by the weight-length relationship indicated that slopes were significant although in comparison with the common slope model, the reduction in the residual (error) mean square was negligible (2%) with r^2 values virtually identical. Excluding fork length, 88% of the remaining variation in the model is accounted for by the main effects. Thus a common slope model was used in further comparisons of intercept differences due to class variable effects. All main effects were significant (Table 7) as was the interaction between year and month. Condition of charr caught in August is greater than those caught in July. Lowest condition has been in the early 1990s and as well for July, in 1985 and 1986 (Fig. 5). Condition has been used as an index of annual growth success (eg. Winters and Wheeler 1994).

Notwithstanding the low estimates for July 1985 and 1986, the low condition values in the early 1990s, which have also observed in the other stock units (Fig. 5), could be suggestive of a commonality of various proximate factors (temperature, food availability, etc.) that have contributed to this apparent pattern.

Nain Stock Unit

N.1 Commercial landings and catch rates

The Nain stock unit consists of an inshore zone made up of Anaktalik Bay, Nain Bay, Tikkoatokak Bay, and Webb Bay subareas, and an offshore island zone made up of the Dog Island and Black Island subareas (Fig. 1). Annual landings have ranged from 13 to 76 t (mean = 47 t, 1974-93), and over this interval have contributed 41% of the commercial catch of charr from the Nain fishing region (Table 8). The highest catches occurred during the late 1970's and early 1980's (Fig. 6), with the lowest catch of 13 t in 1993. The TACs listed in Table 8 for 1979 to 1983 applied to the specific subareas of Anaktalik Bay and Nain-Tikkoatokak Bay only. In 1984 and 1985, an offshore component was included in the TAC. The quota area catch (QAC) in Table 8 summarizes landings for those subareas specifically under quota restrictions only, prior to the derivation of the stock units in 1986. Since 1986, the TAC has applied to the entire stock unit.

Science advice for 1993 recommended a reduction in the reference level catch from 47 t to 32 t. However, the management plan for 1993 maintained the TAC at 47 t.

Landings of Arctic charr from the Nain assessment unit during 1993 totaled 13.4 t, only 29% of the TAC (or 42% of the recommended level), but represented 40% of the overall catch from the Nain fishing region during 1993 (Table 8). This was a decline in the stock unit catch of 31% from the previous year. Effort also decreased by 11% yielding one of the lowest unstandardized catch rates recorded. A summary of landings partitioned by inshore and offshore fishing zones is presented in Table 9.

With respect to the standardized catch rates, separate analyses were done for inshore and offshore fishing zones. For the inshore zone, the regression of ln catch rate for the period 1977-93 explained 69% of the variation in the data. Highest catch rates occurred in the late 1970's and early 1980's and have generally declined over time (Table 10, Fig. 6). Catch rates were highest during weeks 31-33 (July 30- August 19). Since 1991, catch rates have been the lowest recorded. Standardized effort in 1993 was also the lowest recorded (Table 10).

For the offshore zone, the regression of ln catch rate for the period 1977-93 explained 73% of the variation. Highest catch rates also occurred during weeks 31-33 (July 30- August 19) and generally increased until around 1990 (Table 10, Fig. 6). The catch rate in 1993, while 35% less than the 1984-90 average, was still 31% greater than the 1977-83 average. Standardized effort was the lowest recorded in 1992 and 1993 (Table 10).

The Nain stock unit is where the domestic or spring food fishery largely occurs. This fishery is targeted on charr as they migrate to sea. Efforts in the past, both by DFO and more recently by the Labrador Inuit Association, have failed to quantify the amount of charr taken annually in this food fishery. This unaccounted for harvest has not been factored into the commercial landings or catch at age estimates. Removals from the spring food fishery could be more significant during the past three years (1991-93) when overall commercial landings have averaged only 16 $t \cdot y^{-1}$ in contrast to the 1977-90 period when commercial landings averaged over 54 $t \cdot y^{-1}$. In recent years, the LIA has expressed concern about this fishery.

N.2 Timing of the fishery

Figure 4 illustrates the timing of the fishery for the Nain stock unit from 1977-93. The median date of the catch from 1977-90 was day 207 (July 26). Landings in 1991 were three weeks later than this average (median day 229, August 17), while in 1992 landings were about four weeks later (day 234, August 22) and compressed over a rather short interval (Fig. 4). The 1993 fishery was two weeks later (median day 220, August 8) than the 14-year (1977-90) average.

Further insight can be gained by examining the timing within the respective inshore and offshore fishing zones (Fig. 7). On average over the 14-year period 1977-90, the median timing of the catch in the offshore zone was about 14 days later than the inshore zone. With respect to the inshore zone, median timing of the 1991-93 fisheries have been 21 to 31 days later than the 1977-90 average. For the offshore zone, timing in 1991 and 1992 was about 2 weeks later, but for 1993 the median date of the catch was actually 6 days earlier (Fig. 7).

N.3 Catch at age

Catch at age data are available since 1977 (Table 11). Typically, four age classes (ages 7-10) make up 82% of the catch. Charr are first recruited into the fishery at age 6 and ages over 12 contribute little to the fishery. The 1984 and 1985 year classes (year of hatching) represented by 8 and 9 year old fish were the most abundant in 1993 contributing 54% of the catch.

These year classes appear to follow through from their strong contributions in 1992. Mean age of the catch has ranged from a high of 9.8 years in 1982 to a low of 8.5 years in 1977. In general, mean age of the catch has varied little over time ($\bar{x}$ = 9.1 yrs, CV = 4.1%).

Sequential population analyses were not carried out on the most recent data. As noted above, effort in 1993 has been among the lowest recorded and thus there is little basis for an adequate catch rate series from which to calibrate the sequential population analyses.

N.4 Size at age and condition

Weights at age were derived from length-weight relationships obtained from sampling the commercial fishery as explained in past years (Dempson 1990). A comparison of the recorded total landings for 1993 with the cross product total (sum of the matrix of estimated numbers at age x matrix of weights at age) agreed quite well with the discrepancy between the two of about 0.1%. As identified in previous years, weights at age have declined over time (Table 12). Part of the reason for the overall decline in mean weight in recent years could be directly related to the timing of the fishery. As noted earlier, larger charr return to the rivers first with fish returning to freshwater as early as the second week of July (Dempson and Green 1985). This is further illustrated in Figure 8 which shows the change in size composition of Arctic charr returning to Ikarut River over the summer. During the past several years, the median timing of the Nain stock unit fishery has been up to three and four weeks later in comparison with 'average' timing over a 14-year period.

In addition to the timing of the fishery, several other factors may have contributed to the smaller size of fish in the catch. With the decline in the catch of salmon at Nain in recent years ($\bar{x}$ = 20 t, 1985-89, versus $\bar{x}$ = 2.4 t, 1991-93), there has been proportionally more 114 mm mesh gill nets used rather than both 114 and 127 mm mesh nets. In the later part of August, some gear has been set close to river mouths in some bays. When set in these locations where there is a strong influence of both tide and river current, the nets are stretched more and are effectively fishing as a smaller mesh gear. For the 1993 fishing season, the local fish plant was also instructed to accept charr that were within the 0.45-0.91 kg weight range (1-2 pound). Typically in the past, charr less than 0.91 kg were not accepted. This, however, should not be a major factor. Several questionnaire surveys conducted in past years with local fisherpersons indicated that few charr of this size were actually caught. This was also apparent in DFO research sampling carried out in 1978-80 with various mesh size gear. For the Nain stock unit in 1993, Arctic charr in the 0.45-

0.91 kg category made up only 3.9% of the catch (4.1% at Voisey, 0% at the Okak unit).

Analysis of condition indicated that slopes were also significant for the Nain stock unit although again in comparison with the common slope model, the reduction in the residual (error) mean square was minimal (3%) with r^2 values virtually identical. Excluding fork length, 83% of the remaining variation in the model is accounted for by the main effects. Thus a common slope model was used in further comparisons of intercept differences due to class variable effects. All main effects were significant (Table 7) as was the interaction between year and month. Condition of charr caught in August is again greater than those caught in July. Similarly, the lowest condition values have been recorded during recent years (Fig. 5).

Okak Stock Unit

0.1 Commercial landings and catch rates

The Okak stock unit consists of an inshore component made up of Okak Bay and an offshore island zone made up of the Cutthroat subarea (Fig. 1). Annual landings have ranged from only 180 kg in 1992 to a high of 76 t in 1978 (mean = 29 t, 1974-93), and over this interval have contributed 21% of the commercial catch of charr from the Nain fishing region (Table 13). The highest catches occurred during the late 1970's and early 1980's (Fig. 9), with the lowest catches during the past two years. The Total Allowable Catches (TAC) listed in Table 13 for 1981 to 1985 applied only to the Okak Bay subarea. The recommended TAC in 1993 was maintained at 31 t.

Landings of Arctic charr from the Okak assessment unit during 1993 totaled 0.6 t. For the past two years, no fishing has been carried out within Okak Bay itself and virtually no effort has been directed to the offshore Cutthroat subarea. Families that had traditionally fished this stock unit no longer participate in the fishery and have not done so for the past several years.

With respect to the standardized catch rates, separate analyses were done for inshore and offshore fishing zones. For the inshore zone, the regression of ln catch rate for the period 1977-91 explained 64% of the variation in the data. Highest catch rates occurred in the late 1970's and early 1980's with a moderately high value in 1990 (Table 14, Fig. 9). Catch rates were also highest during weeks 31-33 (July 30-August 19). The lowest catch rates were in 1985, 1988 and 1989. The low effort in 1981, 1982 and 1984 was directly related to the expanded fisheries in the northern fiord subareas of Hebron and Saglek. The low catch in 1991 was related to the low directed effort in Okak Bay.

For the offshore zone (Cutthroat), the regression of ln catch rate for the period 1977-93 explained 75% of the variation. Highest catch rates also occurred during weeks 31-33 (July 30-August 19). Catch rates were highest again in the late 1970's and early 1980's but have been generally quite variable over the entire sequence of years (Table 14, Fig. 9). With the extreme low landings and effort in the past several years, interpretation of the commercial catch rate series as an index of abundance is questionable.

0.2 Timing of the fishery

Figure 4 illustrates the timing of the fishery for the Okak stock unit from 1977-93. The median date of the catch from 1977-90 was at day 222 (August 10). While landings in 1991 were about 9 days later than this average (median day 231, August 19), the 1992 and 1993 fisheries, albeit rather limited, occurred earlier than the median date (Fig. 9). In general, the median date of the catch in Okak Bay occurred about a week and a half after that at Cutthroat and reflects the former pattern of availing of the salmon by-passing the Cutthroat area before moving into Okak Bay to intercept the run of charr back to the rivers.

0.3 Catch at age

Catch at age data are available since 1977 (Table 15). Until about 1988, four age classes (ages 8-11) made up 77% of the catch. This declined to about 71% in 1989-91. The youngest charr caught in the Okak fishery are age 6 but these are generally few in number. Okak charr age distribution is generally more variable than the Voisey or Nain stock units and the mean age of the fish is often older. As indicated above, there has been virtually no fishery in the Okak stock unit during the past two years. Estimated numbers at age may not be representative for 1992 and 1993 as sampling was rather sparse. Data are included, however, for completeness.

Analytical sequential population analyses have not carried out on the Okak stock unit in recent years. Calibration attempts in past years were the least successful for the Okak unit. The limited effort directed towards the Okak unit since 1991 precluded any attempts to estimate stock size using rigorous analytical sequential population models.

0.4 Size at age and condition

Weights at age were derived in a manner consistent with the other stock units. A comparison of the recorded total landings with the cross product total (sum of the matrix of estimated

numbers at age x matrix of weights at age) has agreed quite well in the past with the discrepancy between the two of less than 0.6%, for example for 1989-91. Weights at age have been more consistent than in the other two major stock units, and have not experienced the same degree of declined over time (Table 16). The limited data for 1992 and 1993 preclude any comment of events in recent years.

Analysis of condition indicated that slopes were significant for the Okak stock unit. Again, however, in comparison with the common slope model, the reduction in the residual (error) mean square was minimal (<2%) with r^2 values virtually identical. Excluding fork length, 90% of the remaining variation in the model is accounted for by the main effects. Thus a common slope model was used in further comparisons of intercept differences due to class variable effects. All main effects were again significant (Table 7) as was the interaction between year and month. Consistent with the other stock units, condition of charr caught in August is again greater than for charr caught in July. The lowest condition indices recorded for August have been in 1992 and 1993. Similarly, lowest condition values for July have occurred in 1992 but also in 1984 and 1985 (Fig. 5).

Conclusions

Much of the decline in Arctic charr landings in the Nain fishing region during the past eight years can be attributed to a continued decline in effort directed towards the fishery. As acknowledged earlier, assessments of several of the stock units have also indicated that stock sizes have also declined over time and were below levels during the late 1970's and early 1980s. This in itself could also have contributed to the trend for diminished landings. Stock sizes were estimated using sequential population analyses (SPA) calibrated with commercial catch rate information. The latter may not be entirely appropriate as a calibration tool. Particularly in recent years, effort has been extremely low and thus the spatial coverage of fishing may be insufficient to draw conclusive results with respect to overall stock abundance. It has also been pointed out in the past that independent estimates of stock size were not available either to calibrate SPA runs, or to provide actual census information on current stock sizes returning to north Labrador rivers (Dempson 1993b).

Some local fisherpersons at Nain have indicated that part of the reason for the low abundance of charr in 1993 was due to a lack of snow during the past winter (Norm Andersen, DFO Fisheries Officer, Nain, Labrador, personnel communication). The absence of snow made the spring run-off virtually non-existent. These fisherpersons thus concluded that many charr did not migrate to sea in 1993. Without census information on specific rivers, this 'hypothesis' could not be addressed, but is noted as a valid comment from local individuals. Comments from fisherpersons have

also included reference to a noticeable absence of local bay capelin stocks. Some fisherpersons at Nain believe that this is a contributing factor for charr not remaining within the inner bay areas during the past 8-10 years. This is consistent with observations on the distribution of tag recaptures with more returns from the offshore zone, and the change in catch rates from inshore and offshore fishing zones of the Nain stock unit.

The salmon licence buy-out was extended to north coastal fisherpersons in August of 1993. This has effectively removed a number of fisherpersons from actively participating in subsequent years as the 'buy-out' considered both commercial charr and salmon fishing. It is expected that the Nain stock unit will continue to receive most of the directed effort in subsequent years a fact also acknowledged by the Nain fisherpersons committee. This is due to the importance of the spring food fishery, particularly at Nain Bay, and the proximity of this entire stock unit to the local fish plant; collector boats are not necessary. Viable fisheries directed towards Arctic charr are still possible in northern Labrador. Fisheries occurring within the inner bays and fiords will, for the most part, intercept few salmon. Many of the areas to the north of Okak Bay are underutilized. Fisheries in these areas have not been undertaken on a continuous basis and could conceivably provide alternatives for rotational fisheries or river-specific harvesting programs.

It is suggested that the advice supplied for the 1993 fishery be implemented for 1994. Specifically, this called for a 30% reduction in the reference level catch for the Nain stock unit with the Voisey and Okak units remaining as in 1993. Future fisheries will differ from the intense harvesting levels experienced in the past. Emphasis on quality rather than quantity has been a concern and has been partially addressed by conducting experimental in-river fisheries. To date, there is continued interest in the latter.

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Table 1. Summary of northern Labrador Arctic charr landings (kg round) by fishing region, 1974-93.

	Nain Fishing Region				Makkovik Fishing Region			
Year	Catch	No. of Fishermen	Fathoms of gear licensed	Catch as % of total	Catch	No. of Fishermen	Fathoms of gear licensed	Total Catch
1974	120414	66		81	28133			148547
1975	44118	85		82	9542			53660
1976	134898	101		90	15645			150543
1977	186165	128		88	24205			210370
1978	213915	131	21340	86	34387	149	29300	248302
1979	175263	142	21320	82	37693	110	21225	212956
1980	167991	128	23960	83	35561	154	30635	203552
1981	231221	122	21700	92	20733	154	30990	251954
1982	203012	118	23600	84	39163	141	28200	242175
1983	149732	119	24400	84	29100	148	29600	178832
1984	123045	115	23000	83	24792	147	29400	147837
1985	107120	95	19000	76	33945	132	26400	141065
1986	99963	79	15800	88	13888	109	21800	113851
1987	97379	72	14400	91	9965	130	26000	107344
1988	74010	63	12600	83	14819	120	24000	88829
1989	85970	72	14400	85	14808	126	25200	100778
1990	86292	67	13400	86	13509	103	20600	99801
1991	54614	65	13000	78	15137	96	19200	69751
1992	60754	62	12400	82	13044	96	19200	73798
1993	33562	36	7200	88	4622	90	18000	38184
Avg. 1988-92	72328				14263			86591
Avg. 1983-92	93888				18301			112189
Avg. 1974-93	122472			85	21635			144106

For 1985, Makkovik Region, catch includes 6788 kg from spring fishery in Postville area.
Catch for Nain Fishing Region includes in-river harvest in 1989, 1991, and 1992, and the trap net fishery at Nachvak Fiord in 1986.

Table 2. Summary of Arctic charr landings (kg-round) from various experimental fisheries in northern Labrador.

		Type of Fishery		
Year	Area	Trap-net	River gill net	In-river trap
1986	Nachvak Fiord	1777		
1989	Voisey Bay		169	
	Nain Bay		345	
	Tikkoatokak Bay		473	
	Webb Bay		146	
1991	Saglek Fiord			159
1992	Saglek Fiord			2201

* Note these catches are included in the overall summary in Table 1 but are not included in Appendix 1.

Table 3. Catch (kg-round) and effort (person-weeks) statistics for the Voisey assessment unit from 1974 to 1993. Quota area catch (QAC) refers to the landings from those subareas specifically under TAC regulation only, prior to the derivation of assessment units in 1985. CUE is unstandardized.

Year	TAC	QAC	Catch	Effort	CUE	% Offshore	Unit as % of Nain Region Total
1974			29180			31	24
1975			3727			94	8
1976			14652	57	257	21	11
1977			24108	75	321	9	13
1978			36991	102	363	11	17
1979	22500	21880	40590	116	350	47	23
1980	22500	11557	19694	82	240	42	12
1981	16100	16325	23810	90	265	33	10
1982		2688	13309	60	222	45	7
1983	16100	2953	25593	80	320	89	17
1984	16100	8133	20873	101	207	62	17
1985	23400		15648	57	275	91	15
1986	23400		16655	82	203	82	17
1987	17000		21242	101	210	41	22
1988	17000		14037	52	270	60	19
1989	17000		11019	32	344	100	13
1990	17000		19895	69	288	64	23
1991	17000		10971	60	183	26	20
1992	14000		9284	39	238	96	15
1993	14000		8461	48	176	23	25
Avg. 1988-92			13041				
Avg. 1983-92			16522				
Avg. 1974-93			18987				

TAC applied only to Voisey Bay subarea from 1979 to 1984.

Table 4. Standardized catch rates (C/E, kg/person-week fished) with standard error (SE) and estimated effort for the Vosiey Stock Unit Arctic charr fishery, 1977-93.

Year	C/E	SE	Effort
1977	316	52	76
1978	387	62	96
1979	406	65	100
1980	312	51	63
1981	310	48	77
1982	214	34	62
1983	454	78	56
1984	277	43	75
1985	352	56	44
1986	258	40	65
1987	271	52	78
1988	308	48	46
1989	385	70	29
1990	346	60	57
1991	198	32	55
1992	323	62	29
1993	248	45	34

Table 5. Estimated catch at age from the commercial Arctic charr fishery in the Voisey stock unit, 1977-1993.

	CATCH AT AGE																
AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
6	318	619	475	154	68	316	1045	291	1	44	8	140	68	17	9	364	494
7	2085	4374	4914	803	915	755	2947	2891	1917	351	1312	1638	911	1110	909	1198	2088
8	4030	5372	7928	3386	2571	1566	3410	3254	3066	3230	2813	2319	1445	2865	1047	1034	1344
9	2086	2330	3382	4140	4803	2346	3449	2238	3242	3888	4420	1465	1520	2945	1625	1511	1025
10	1237	1236	1163	1424	2359	1226	1611	1392	433	1400	2029	1440	1135	1827	1257	1099	574
11	600	1141	634	500	941	657	1084	753	324	686	966	771	702	1083	691	480	237
12	389	380	212	238	406	65	827	414	233	244	280	289	245	588	362	241	98
13	212	380	159	159	41	13	147	355	64	149	38	28	107	440	155	30	10
14	108	334	55	28	19	27	45	83	55	123	57	43	183	136	89	0	3
6+	11065	16166	18922	10832	12123	6971	14565	11671	9335	10615	11923	8133	6316	11011	6144	5973	5896
7+	10747	15547	18447	10678	12055	6655	13520	11380	9334	10571	11915	7993	6248	10994	6135	5609	5402

Table 6: Average weight at age (kg-round) from the Voisey stock unit commercial catch of Arctic charr, 1977-93.

AVERAGE WEIGHT AT AGE

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
6	1.53	1.53	1.53	1.03	0.93	1.20	1.33	1.25	1.05	1.07	1.03	1.23	1.27	1.12	1.11	1.17	0.98
7	1.77	1.77	1.77	1.24	1.26	1.46	1.54	1.53	1.39	1.21	1.41	1.50	1.43	1.48	1.47	1.32	1.30
8	2.07	2.07	2.07	1.60	1.77	1.70	1.64	1.71	1.63	1.44	1.73	1.69	1.68	1.70	1.64	1.44	1.50
9	2.60	2.60	2.60	1.89	2.04	2.02	1.89	1.93	1.77	1.64	1.80	1.78	1.79	1.83	1.79	1.62	1.58
10	2.78	2.78	2.78	2.19	2.17	2.20	2.04	2.06	1.98	1.72	1.95	1.89	1.95	1.94	1.84	1.70	1.73
11	2.94	2.94	2.94	2.42	2.30	2.49	2.18	2.14	1.99	1.90	2.02	1.98	2.06	2.01	2.01	1.90	1.85
12	3.24	3.24	3.24	2.49	2.37	2.33	2.10	2.32	2.18	1.90	1.92	1.88	1.90	1.98	2.01	1.97	1.92
13	2.60	2.60	2.60	2.70	3.36	2.83	2.20	1.91	2.26	1.97	2.31	2.23	2.04	1.90	2.01	2.51	2.74
14	2.76	2.76	2.76	3.73	2.76	3.42	2.55	1.82	2.26	1.45	1.58	1.45	1.90	2.29	2.15	0.00	2.59

MEAN AGE OF INDIVIDUALS IN CATCH

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	8.62	8.50	8.20	8.86	9.09	8.84	8.63	8.66	8.51	8.97	8.98	8.77	9.18	9.28	9.31	8.70	8.01

MEAN WEIGHT OF INDIVIDUALS IN CATCH

Weight	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	2.28	2.21	2.17	1.83	1.98	1.94	1.78	1.79	1.68	1.58	1.79	1.73	1.78	1.81	1.77	1.57	1.32

Table 7. Results of analyses of the common slope GLM weight-length regression model for the Voisey, Nain, and Okak stock units. Asterisks denote significance at P < 0.01.

Stock Unit	N	Slope	Intercept	r**2	Source of variation	DF	Type III SS	F	P
Voisey	6853	2.79**	-10.70**	0.91	Log-length	1	835.81	66823.41	0
					Month	1	5.10	407.73	0
					Year	16	19.21	95.98	0
					Month*Year	10	1.48	11.85	0.0001
Nain	15887	2.83**	-10.87**	0.89	Log-length	1	1547.29	99999.99	0
					Month	1	16.52	1264.11	0
					Year	16	29.24	139.82	0
					Month*Year	13	3.19	18.75	0
Okak	7868	2.72**	-10.47**	0.89	Log-length	1	714.88	60432.32	0
					Month	1	7.48	632.18	0
					Year	16	14.91	78.76	0
					Month*Year	14	1.67	10.06	0.0001

Table 8. Catch (kg) and effort (person-weeks) statistics for the Nain assessment unit from 1974 to 1993. Quota area catch (QAC) refers to the landings from those subareas specifically under TAC regulation only, prior to the derivation of assessment units in 1986. CUE is unstandardized.

Year	TAC	QAC	Catch	Effort	CUE	% Offshore	Unit as % of Nain Region Total
1974			37745			18	31
1975			33830			8	77
1976			53313	196	272	5	40
1977			76255	291	262	7	41
1978			73763	314	235	4	34
1979	61000	52832	66844	336	199	18	38
1980	61000	50176	75055	390	192	30	45
1981	37160	37223	65632	278	236	24	28
1982	43600	39119	55617	235	237	22	27
1983	51000	19102	51202	289	177	34	34
1984	43200	29063	38900	244	159	37	32
1985	30500	36019	41158	252	163	48	38
1986	43000		37095	185	201	56	37
1987	47000		45872	200	229	61	47
1988	47000		38295	229	167	62	52
1989	47000		51465	183	281	41	61
1990	47000		45275	188	241	62	52
1991	47000		15892	149	107	10	29
1992	47000		19555	131	149	46	32
1993	47000		13410	116	116	58	40
Avg. 1988-92			34096				
Avg. 1983-92			38471				
Avg. 1974-93			46809				

TAC applied only to Anaktalik Bay and Tikkoatokak Bay from 1979 to 1983 (1983 also includes 5 t for Nain Bay) but includes an offshore component from 1984 to 1985.

Table 9. Summary of catch and effort statistics for the Nain stock unit, 1974-93. Quotas and landings are in kg round weight, effort is expressed as person-weeks fished. Refer to text for information on quotas and quota area catch. CUE = unstandardized catch per unit effort.

	Inshore			Offshore				Total				
Year	Catch	Effort	CUE	Catch	Effort	CUE	% Catch offshore	Catch	Effort*	CUE	TAC	Quota Area Catch
1974	30822			6923			18.1	37745				
1975	31076			2754			8.1	33830				
1976	50813	146	348	2500	52	48	4.7	53313	196	272		
1977	70908	183	387	5347	114	47	7	76255	291	262		
1978	70465	212	332	3298	106	31	4.5	73763	314	235		
1979	54967	189	291	11877	152	78	17.8	66844	336	199	61000	52832
1980	52328	183	286	22727	215	106	30.3	75055	390	192	61000	50176
1981	49956	157	318	15676	131	120	23.9	65632	278	236	37160	37223
1982	43108	119	362	12509	117	107	22.2	55617	235	237	43660	39119
1983	33603	147	229	17599	149	118	34.4	51202	289	177	51000	19102
1984	24558	131	187	14342	128	112	36.9	38900	244	159	43200	29063
1985	21527	125	172	19631	130	151	47.7	41158	252	163	30500	36019
1986	16347	91	180	20748	101	205	55.9	37095	185	201	43000	
1987	17840	71	251	28032	135	208	61.1	45872	200	229	47000	
1988	14535	90	162	23759	149	159	62.1	38295	229	167	47000	
1989	30449	103	296	21016	87	242	40.8	51465	183	281	47000	
1990	17069	88	194	28205	108	261	62.3	45275	188	241	47000	
1991	10162	102	100	5730	50	115	36.1	15892	149	107	47000	
1992	10504	71	148	9051	60	151	46.3	19555	131	149	47000	
1993	5591	60	93	7819	59	133	58.3	13410	116	116	47000	

* Total effort should be equal to or less than the sum of the inshore and offshore effort.

Table 10. Standardized catch rates (C/E, kg/person-week fished) with standard error (SE) and estimated effort for the Nain stock unit, 1977-93.

	Inshore Unit			Offshore Unit		
Year	C/E	SE	Effort	C/E	SE	Effort
1977	618	137	115	66	14	81
1978	648	159	109	53	12	63
1979	623	153	88	129	27	92
1980	433	84	121	169	35	135
1981	462	92	108	190	40	82
1982	563	110	77	178	38	70
1983	338	65	99	193	40	91
1984	311	62	79	232	45	62
1985	316	60	68	295	59	67
1986	205	40	80	289	61	72
1987	371	71	48	291	57	96
1988	203	38	72	233	47	102
1989	243	48	125	363	75	58
1990	230	45	74	285	57	99
1991	161	31	63	226	52	25
1992	114	25	92	222	47	41
1993	129	25	43	183	39	43

Table 11. Estimated catch at age from the commercial Arctic charr fishery in the Nain stock unit, 1977-93

	CATCH AT AGE																
AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
6	2003	371	430	75	145	83	470	182	103	210	483	204	903	459	203	269	83
7	9250	6703	4306	960	2118	977	2791	2612	2463	4129	5462	6288	4750	4726	1365	3195	1982
8	12453	13122	11568	10519	6877	4782	5842	4619	6506	7713	6293	7166	9707	6115	2085	3809	2874
9	7630	7984	9593	16342	15435	7255	6996	5671	4722	5862	7548	4688	8464	8844	2631	3166	2525
10	5052	4406	4208	8345	9787	7987	4177	4374	4111	2857	4498	3607	3785	4681	2175	2574	1596
11	2454	2367	2168	4077	3746	4936	4357	2173	2494	1284	2013	1631	2853	1908	874	905	469
12	988	1688	1573	1340	991	2976	2762	1495	1605	625	1375	650	1234	927	444	422	296
13	358	312	418	813	304	561	600	738	901	240	898	324	665	378	183	241	171
14	180	272	312	522	151	451	557	281	534	199	306	136	277	137	92	48	49
15	1	118	34	43	42	59	70	96	322	205	357	52	28	186	48	32	38
16	1	97	14	1	13	46	27	57	93	50	180	20	6	1	36	1	0
17	1	1	1	66	10	23	95	89	21	42	37	40	1	1	2	1	2
6+	40371	37441	34625	43103	39619	30136	28744	22387	23875	23416	29450	24806	32673	28363	10138	14663	10085
7+	38368	37070	34195	43028	39474	30053	28274	22205	23772	23206	28967	24602	31770	27904	9935	14394	10002

Table 12. Average weight at age (kg-round) from the Nain stock unit commercial catch of Arctic charr, 1977-93.

AVERAGE WEIGHT AT AGE

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
6	0.89	1.31	1.37	0.89	0.79	1.13	1.27	1.18	1.10	1.15	1.14	1.13	1.16	1.17	1.29	0.94	0.80
7	1.28	1.71	1.52	1.20	1.18	1.37	1.56	1.40	1.43	1.37	1.33	1.38	1.38	1.42	1.38	1.20	1.16
8	1.77	1.86	1.85	1.52	1.51	1.68	1.66	1.63	1.65	1.56	1.53	1.55	1.56	1.50	1.54	1.33	1.31
9	2.07	2.24	2.02	1.78	1.70	1.84	1.84	1.78	1.78	1.69	1.62	1.63	1.63	1.66	1.59	1.37	1.39
10	2.59	2.41	2.08	1.93	1.76	1.89	1.88	1.88	1.83	1.69	1.65	1.64	1.71	1.76	1.63	1.41	1.42
11	2.86	2.35	2.18	1.83	1.78	1.93	1.88	1.87	1.81	1.68	1.68	1.67	1.68	1.68	1.71	1.54	1.50
12	2.74	2.67	2.41	1.91	1.80	1.96	1.92	1.89	1.83	1.70	1.71	1.71	1.64	1.77	1.70	1.44	1.52
13	3.16	3.34	2.25	1.93	1.74	2.11	1.96	1.93	1.82	1.95	1.68	1.70	1.69	1.65	1.76	1.49	1.38
14	3.28	2.88	1.94	1.97	1.72	1.93	1.77	2.07	1.90	1.79	1.74	1.44	1.74	1.75	1.65	1.52	1.24
15	2.65	2.65	2.65	2.71	2.87	2.26	1.84	1.84	1.89	1.61	1.80	1.68	1.97	1.46	1.66	1.93	1.46
16	2.15	2.15	2.15	2.15	3.88	2.69	2.05	1.46	1.53	1.71	1.61	1.75	2.56	1.97	1.47	1.87	0.00
17	2.45	2.45	2.45	4.43	2.45	2.69	2.28	1.91	1.64	1.64	2.03	1.75	1.64	1.81	4.65	2.38	3.63

MEAN AGE OF INDIVIDUALS IN CATCH

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	8.46	8.75	8.87	9.34	9.28	9.83	9.52	9.40	9.47	8.77	9.10	8.65	8.86	8.92	9.16	8.73	8.75

MEAN WEIGHT OF INDIVIDUALS IN CATCH

Weight	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	1.88	2.06	1.93	1.75	1.66	1.85	1.79	1.74	1.73	1.59	1.56	1.55	1.58	1.60	1.57	1.34	1.33

Table 13. Catch (kg) and effort (person-weeks) statistics for the Okak assessment unit from 1974 to 1993. Quota area catch (QAC) refers to the landings from those subareas specifically under TAC regulation only, prior to the derivation of assessment units in 1986. CUE is unstandardized.

Year	TAC	QAC	Catch	Effort	CUE	% Offshore	Unit as % of Nain Region Total
1974			46891			27	39
1975			5057			53	11
1976			25338	148	171	30	19
1977			42392	243	174	37	23
1978			76024	352	216	54	36
1979			43261	283	153	41	25
1980			49035	253	194	66	29
1981	27300	11049	47541	202	235	78	21
1982	27300	9031	34171	186	184	75	17
1983	21000	30732	48978	286	171	39	33
1984	27000	13864	18146	94	193	25	15
1985	27000	24746	33261	208	160	26	31
1986	42000		28896	172	168	30	29
1987	43000		19649	134	147	20	20
1988	31000		17450	136	128	28	24
1989	31000		16563	163	102	10	20
1990	31000		16125	100	161	22	19
1991	31000		4432	31	143	7	8
1992	31000		180	13	14	100	<1
1993	31000		578	9	64	100	2
Avg. 1988-92			10950				
Avg. 1983-92			20368				
Avg. 1974-93			28698				

Table 14. Standardized catch rates (C/E, kg/person-week fished) with standard error (SE) and estimated effort for the Okak stock unit, 1977-93.

	Inshore Unit			Offshore Unit		
Year	C/E	SE	Effort	C/E	SE	Effort
1977	341	86	81	172	38	90
1978	343	110	105	203	48	202
1979	277	67	94	125	28	142
1980	240	61	73	219	47	148
1981	299	81	37	236	51	158
1982	331	102	27	192	41	134
1983	270	65	114	198	42	96
1984	409	132	34	134	30	34
1985	139	35	178	131	30	65
1986	202	50	100	145	35	60
1987	191	48	82	78	18	50
1988	157	40	80	73	16	67
1989	144	36	104	42	10	38
1990	305	81	41	103	27	35
1991	223	79	18	21	6	16
1992				20	5	9
1993				119	34	5

Table 15. Estimated catch at age from the commercial Arctic charr fishery in the Okak stock unit, 1977-1993.

CATCH AT AGE

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
6	84	205	1	130	39	93	475	220	17	41	42	150	190	80	22	0	9
7	139	2465	1989	638	526	713	1762	1202	2675	2056	1008	1007	1760	1474	577	3	99
8	417	8163	7462	5631	2135	2760	4471	2047	4948	6333	1636	1822	1829	2667	778	18	120
9	1084	5494	4997	9175	7166	4167	5787	1885	5385	5197	3686	2977	2058	2108	693	31	122
10	2667	5594	3299	6487	7615	3848	5601	1621	2740	3291	3247	2241	1718	1267	332	26	62
11	3388	3747	1954	2863	4673	3622	5169	1937	2936	1261	1371	1492	1714	1234	164	11	6
12	5417	3953	878	1382	1330	1542	4075	1290	987	875	395	772	865	556	122	18	10
13	2278	2773	761	407	1044	444	1643	1034	740	562	299	187	296	261	68	7	0
14	1694	514	527	350	459	342	658	514	768	148	166	125	139	94	23	0	0
15	1472	1027	410	262	359	183	307	192	103	170	85	13	52	92	0	0	0
16	832	308	351	90	44	57	107	111	75	8	34	32	56	0	23	0	0
17	277	567	399	178	223	114	68	123	123	3	2	1	16	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0
6+	19749	34810	23028	27593	25613	17885	30123	12176	21497	19945	11971	10819	10700	9856	2802	114	428
7+	19665	34605	23027	27463	25574	17792	29648	11956	21480	19904	11929	10669	10510	9776	2780	114	419

Table 16. Average weight at age (kg-round) from the Okak stock unit commercial catch of Arctic charr, 1977-93.

AVERAGE WEIGHT AT AGE

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
6	1.21	1.21	1.21	1.02	1.29	1.13	1.15	1.16	1.12	1.06	1.14	1.16	1.26	1.13	1.32	0	0.88
7	1.48	1.48	1.48	1.20	1.24	1.38	1.25	1.26	1.27	1.32	1.30	1.33	1.32	1.40	1.48	1.15	1.03
8	1.66	1.66	1.66	1.59	1.51	1.58	1.43	1.41	1.45	1.50	1.43	1.37	1.47	1.55	1.51	1.57	1.29
9	1.85	1.85	1.85	1.77	1.73	1.66	1.56	1.46	1.52	1.64	1.58	1.53	1.51	1.69	1.57	1.41	1.51
10	1.98	1.98	1.98	1.81	1.93	1.75	1.66	1.58	1.67	1.73	1.64	1.60	1.65	1.79	1.80	1.64	1.62
11	2.02	2.02	2.02	1.89	1.89	1.76	1.69	1.52	1.61	1.85	1.64	1.63	1.66	1.76	1.83	1.84	2.32
12	2.36	2.36	2.36	2.05	1.93	1.94	1.76	1.62	1.90	1.85	1.75	1.76	1.77	1.88	1.66	1.63	2.30
13	2.30	2.30	2.30	2.47	2.10	2.01	1.73	1.64	1.77	1.77	1.87	1.85	1.86	1.74	1.72	1.84	0
14	2.38	2.38	2.38	2.10	1.87	2.02	1.52	1.68	1.66	1.72	1.97	1.74	1.99	1.84	1.63	0	0
15	2.48	2.48	2.48	1.83	1.93	2.18	1.81	1.76	2.04	1.60	2.04	2.31	1.89	1.63	0	0	0
16	2.30	2.30	2.30	2.82	1.54	1.65	1.70	1.66	1.89	2.72	2.48	1.91	1.76	0	1.63	0	0
17	2.30	2.30	2.30	2.37	2.39	2.56	2.73	2.10	2.07	0	0	0	2.17	0	0	0	0
18	2.30	2.30	2.30	2.58	3.17	1.84	2.07	0	3.16	1.68	0	0	2.30	0	0	0	0
19	2.30	2.30	2.30	2.69	0	0	2.07	1.43	1.37	0	0	0	0	1.84	0	0	0

MEAN AGE OF INDIVIDUALS IN CATCH

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	12.00	10.08	9.53	9.58	10.11	9.96	10.05	10.14	9.47	9.10	9.82	9.46	9.43	9.19	8.85	9.93	8.44

MEAN WEIGHT OF INDIVIDUALS IN CATCH

Weight	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
	2.20	1.95	1.86	1.77	1.83	1.72	1.60	1.51	1.54	1.60	1.58	1.53	1.56	1.64	1.58	1.58	1.37

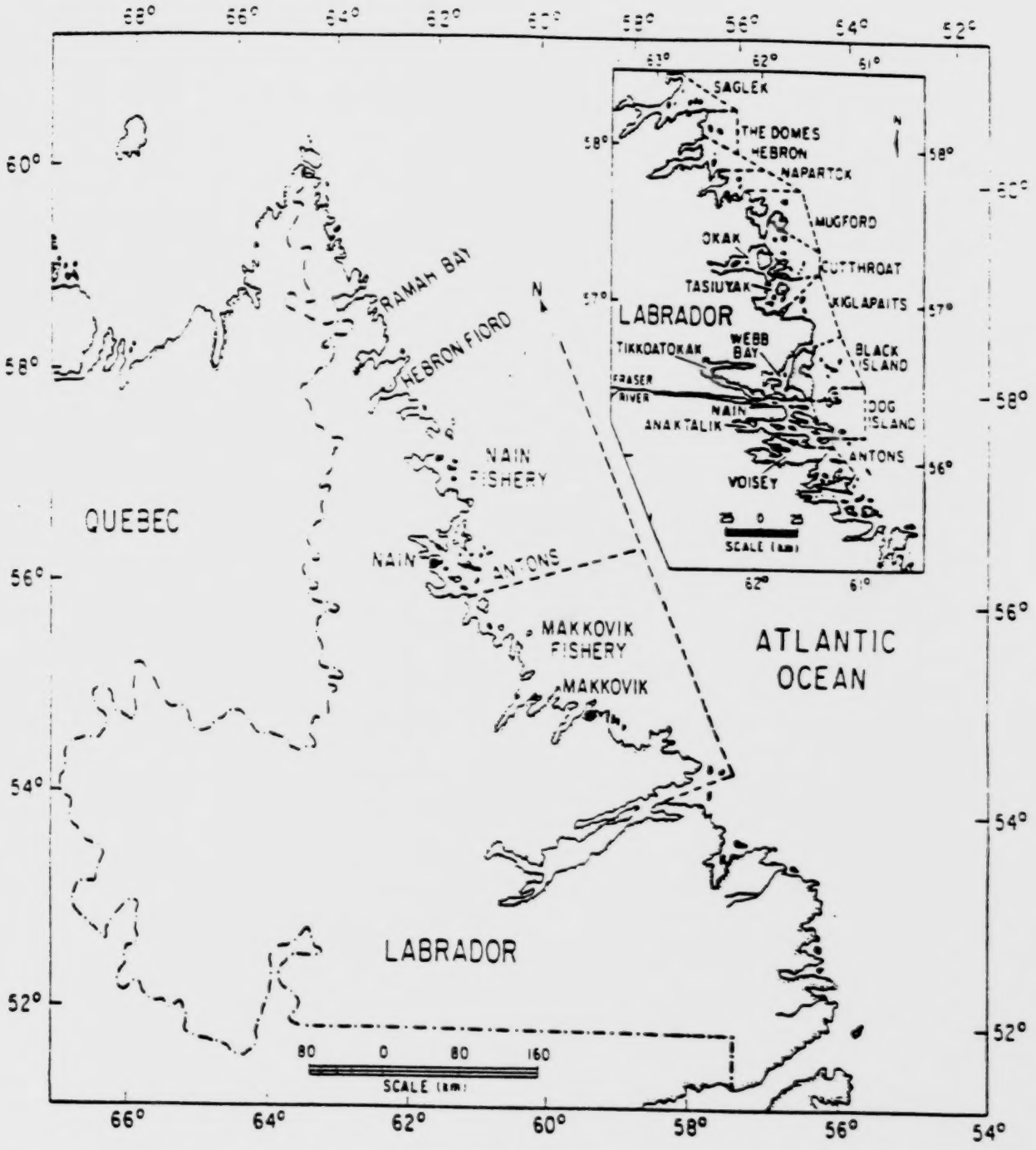


Fig. 1. Location of the Nain and Makkovik Fishing Regions in northern Labrador. Insert illustrates the location of subareas within the Nain Fishing Region.

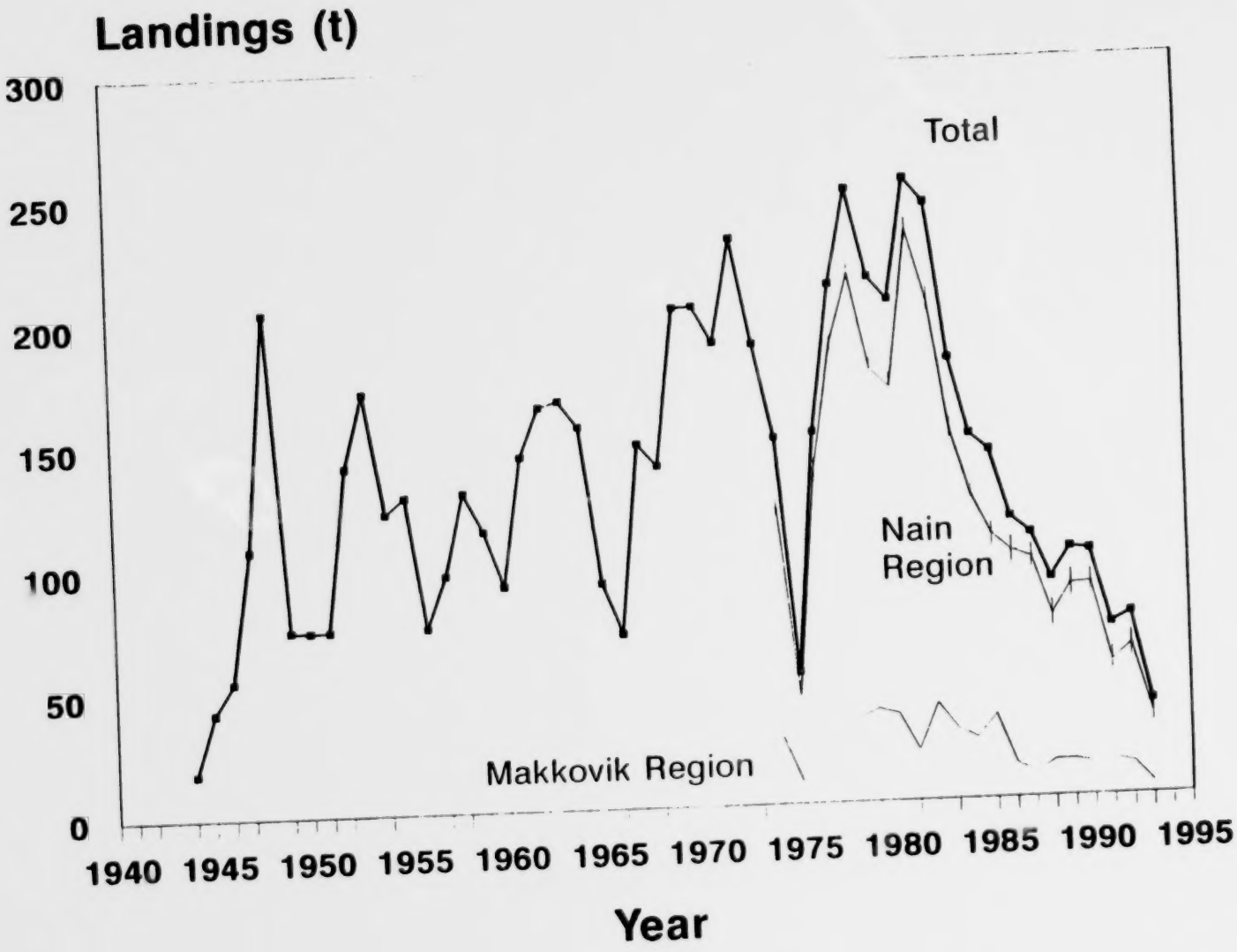
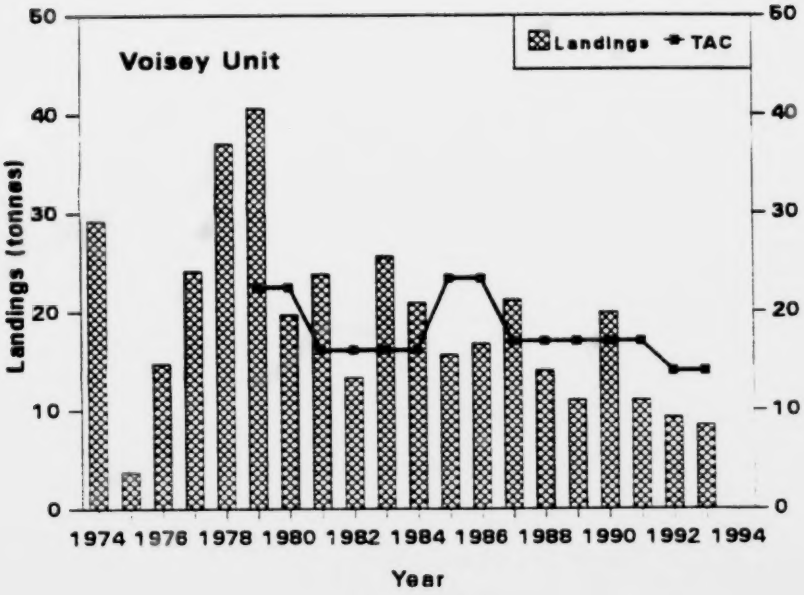


Fig. 2. Summary of northern Labrador Arctic charr landings (tonnes), 1944-93.



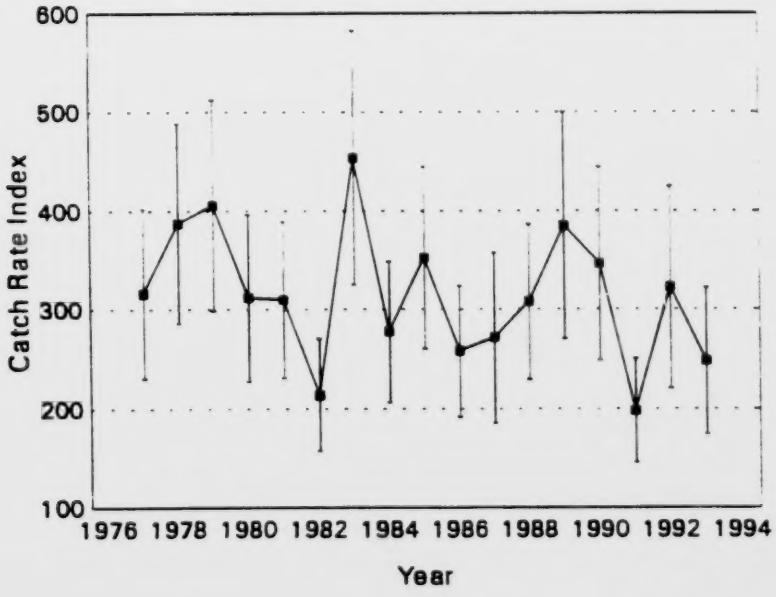


Fig. 3. Commercial landings of anadromous Arctic charr from the Voisey stock unit, 1974-93, in relation to the total allowable catch (upper pannel), and estimated commercial catch rates (kg/person-week fished, lower pannel). Vertical lines represent ± one standard error about the mean.

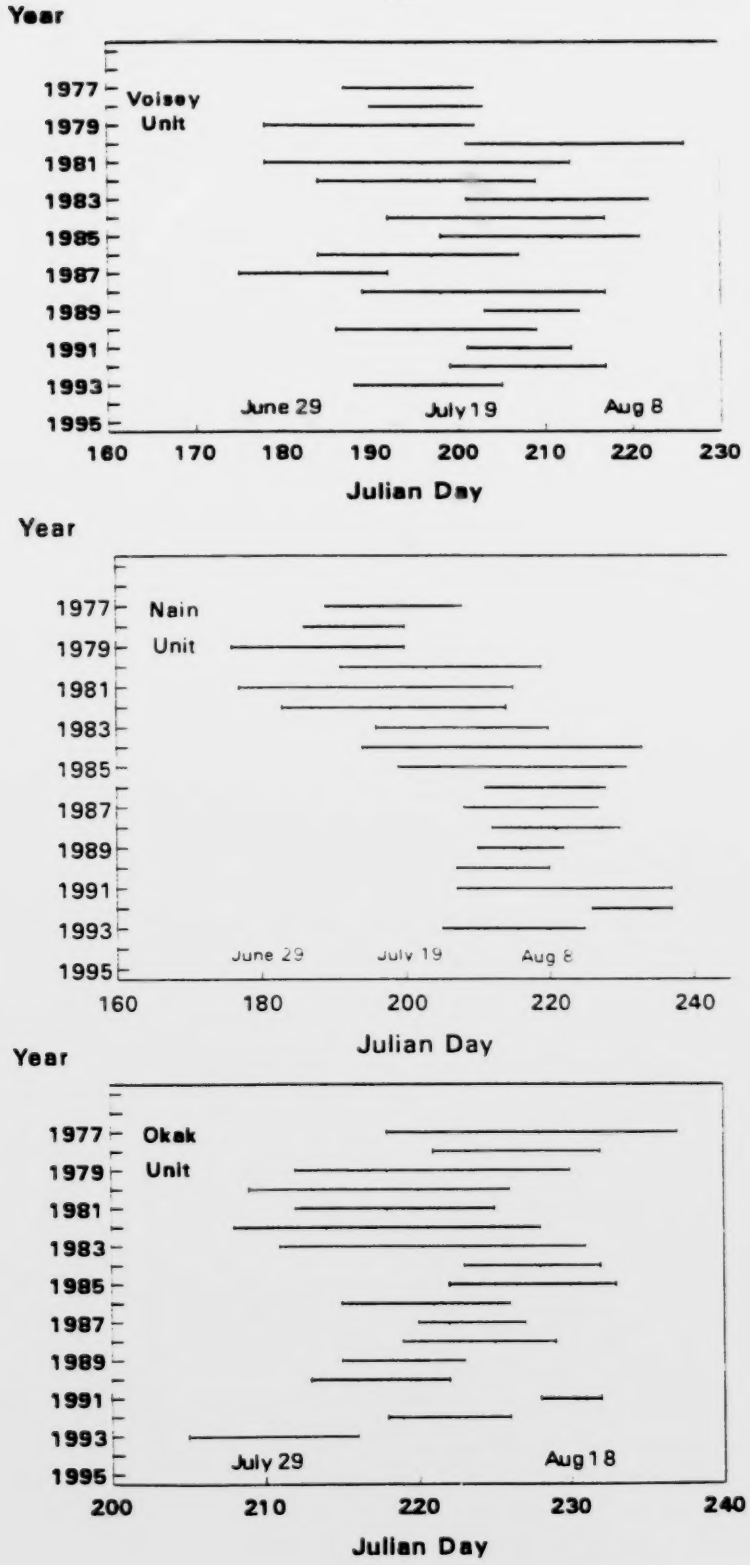


Fig. 4. Commercial catch timing of the Voisey, Nain and Okak stock unit Arctic charr fisheries, 1977-93. The median date (50%), along with the 25th and 75th percentiles are illustrated.

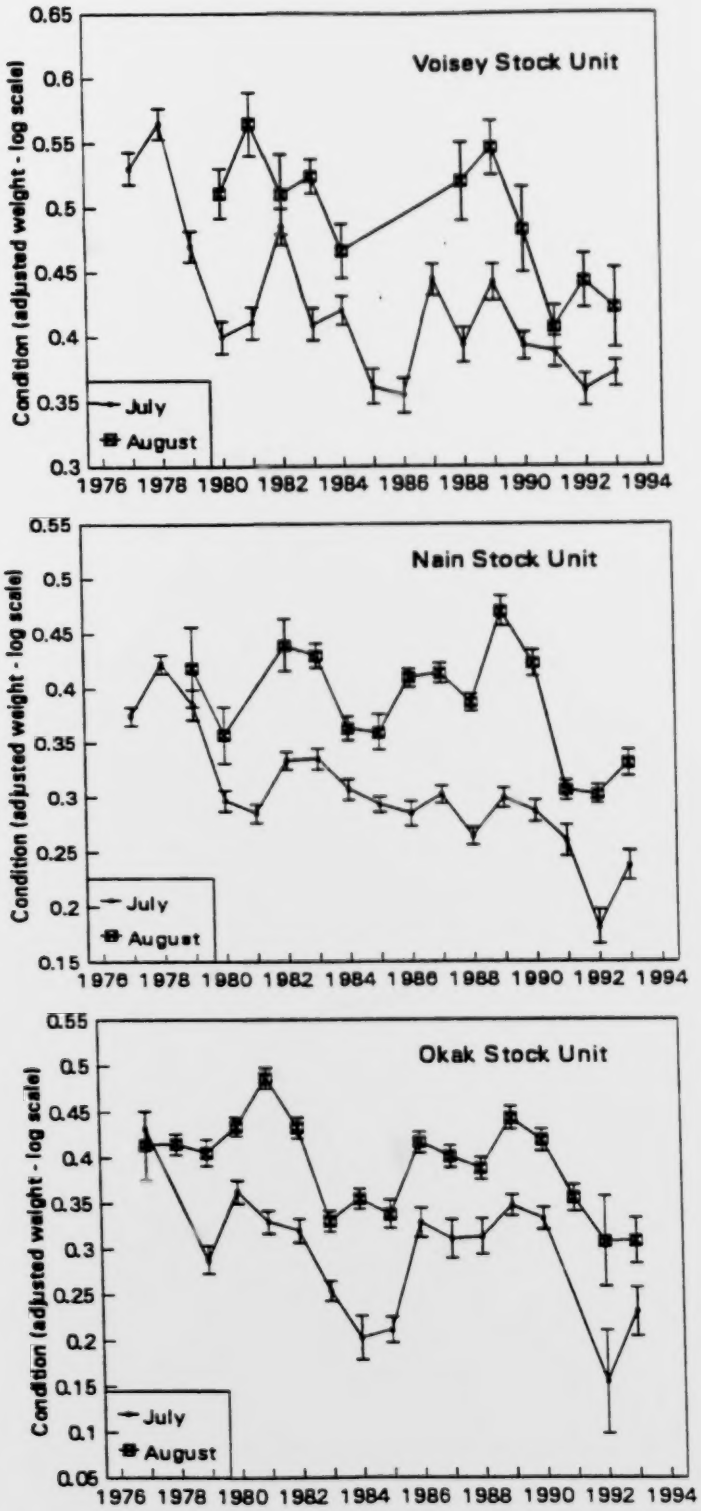
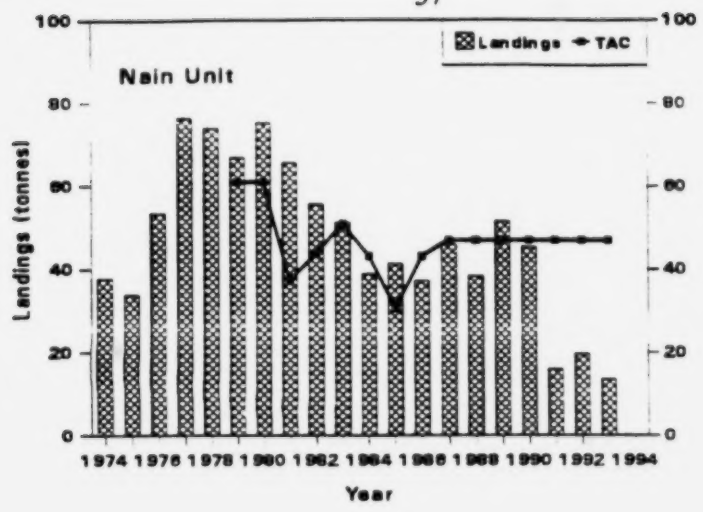
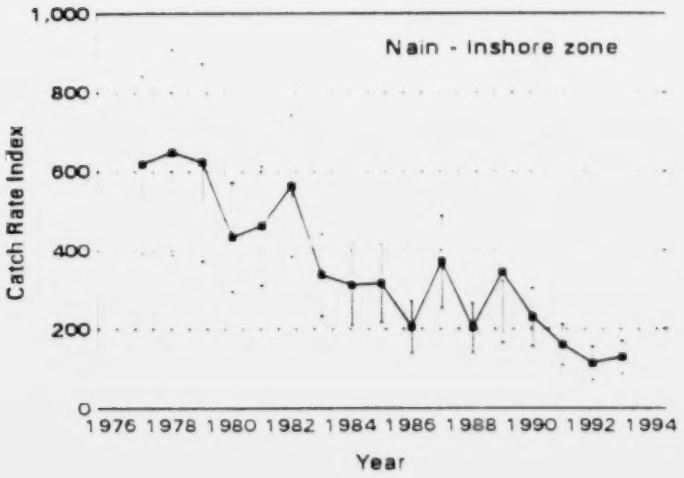


Fig. 5. Temporal variation in condition of Arctic charr for the Voisey, Nain, and Okak stock units, 1977-93. July and August months are shown separately. The vertical lines represent ± two standard errors about the mean.





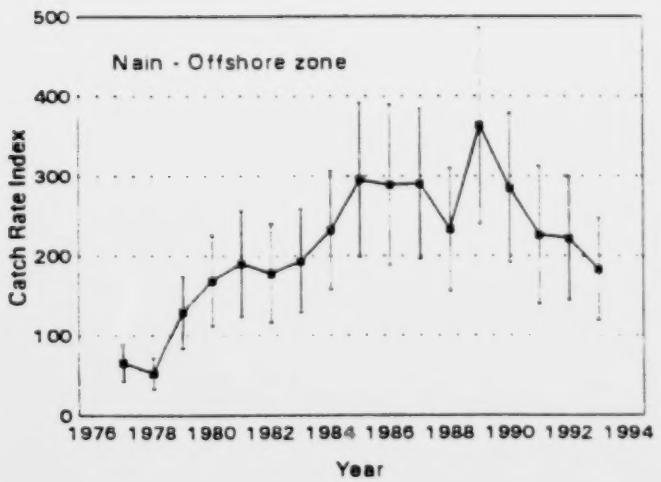
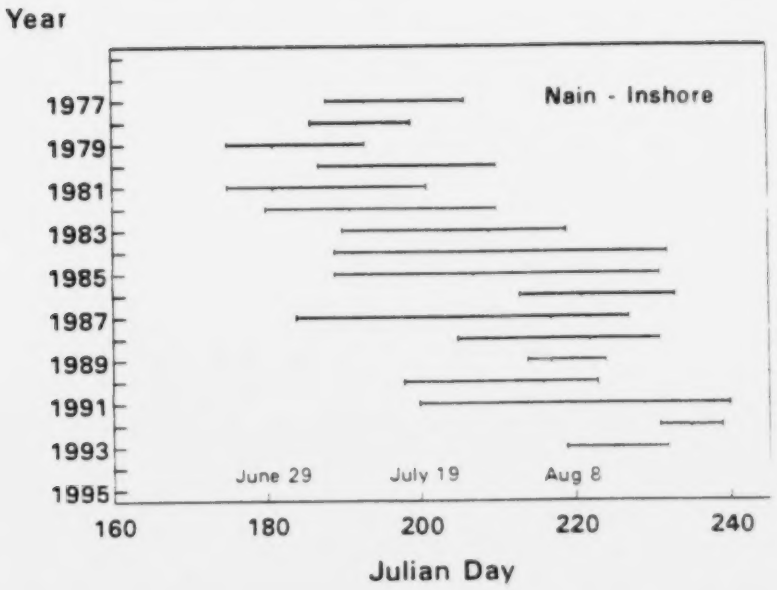


Fig. 6. Commercial landings of anadromous Arctic charr from the Nain stock unit, 1974-93, in relation to the total allowable catch (upper pannel), and estimated commercial catch rates for inshore and offshore fishing zones (kg/person-week fished, lower pannel). Vertical lines represent ± one standard error about the mean.



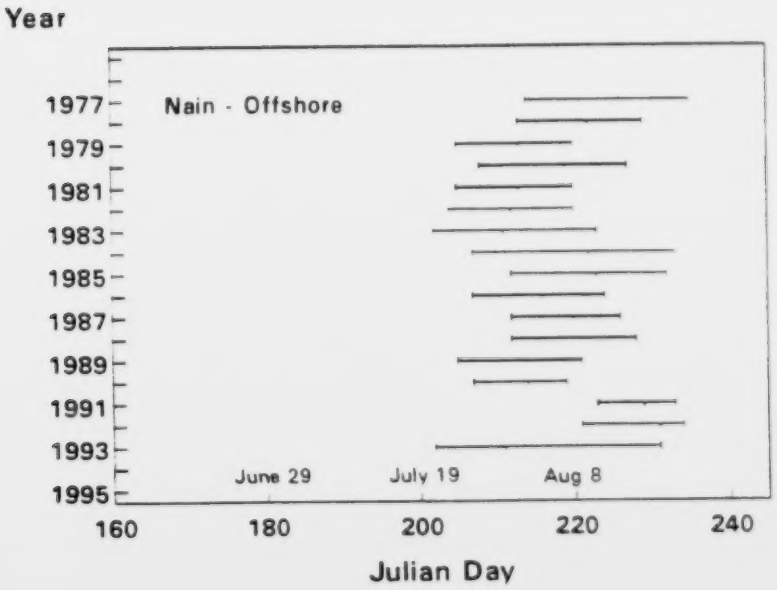


Fig. 7. Commercial catch timing of the Nain stock unit Arctic charr fishery for inshore and offshore zones, 1977-93. The median date (50%), along with the 25th and 75th percentiles are illustrated.

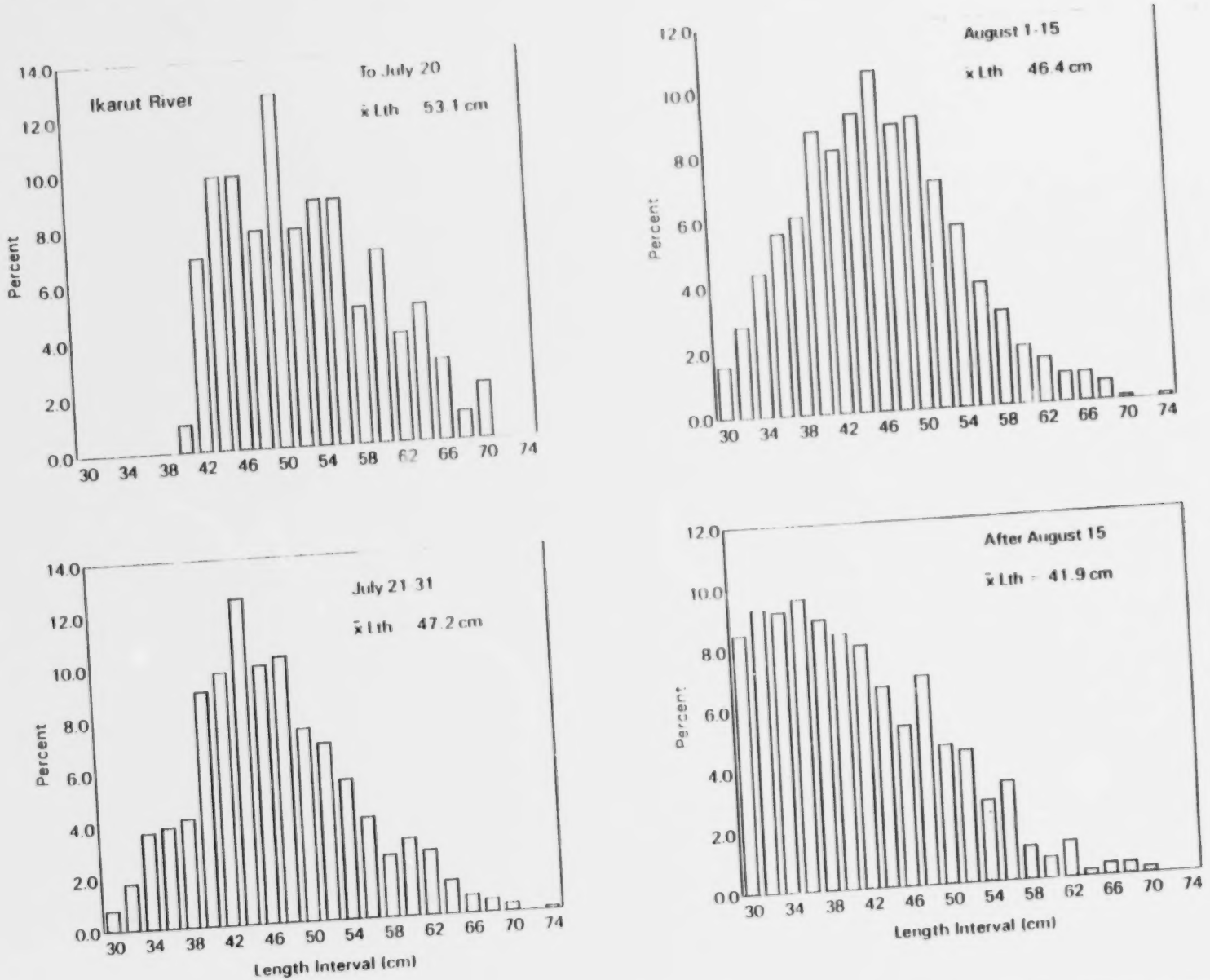


Fig. 8. Length-frequency distribution of anadromous Arctic charr (≥ 30 cm) from Ikarut River, Hebron Fiord, Labrador, 1981-85. Data are illustrated by varying time intervals throughout the upstream run.

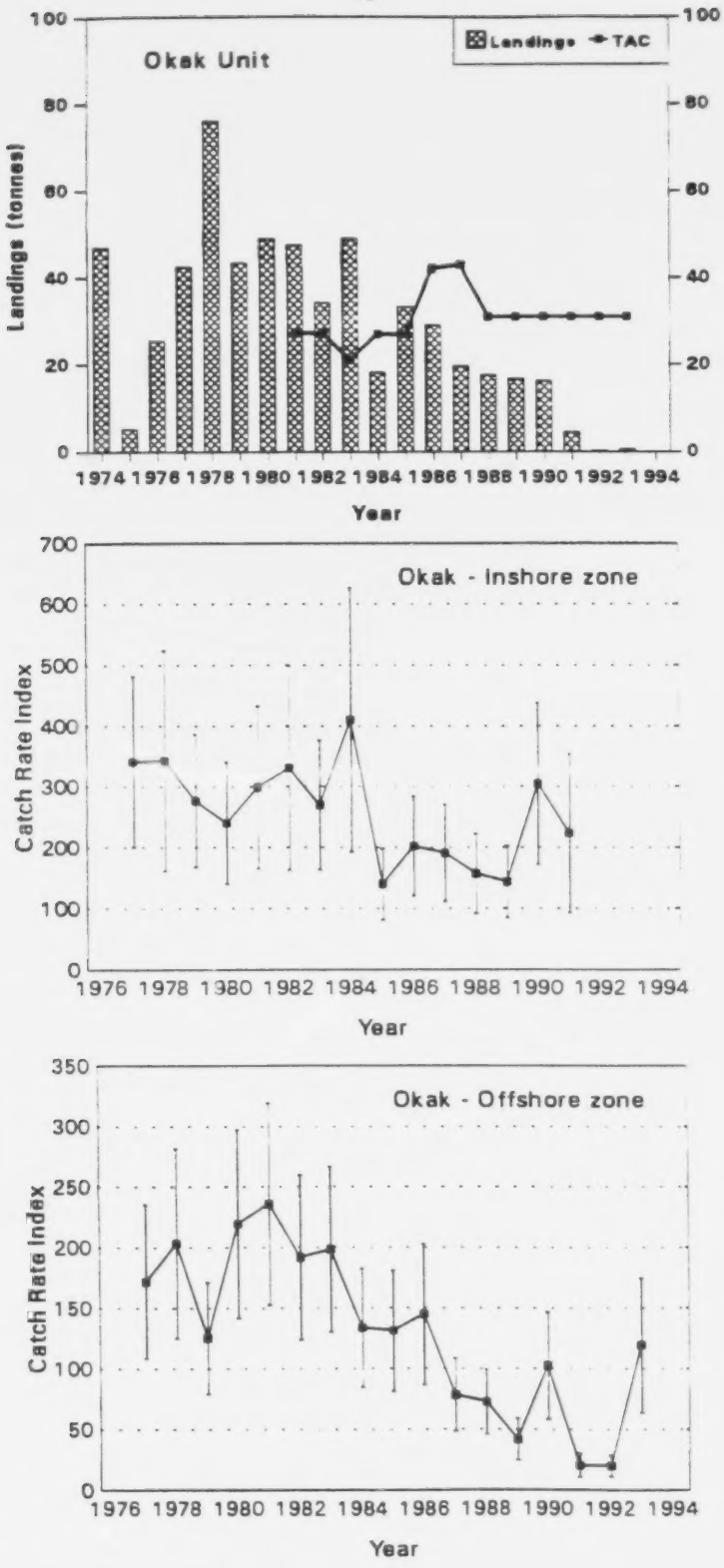


Fig. 9. Commercial landings of anadromous Arctic charr from the Okak stock unit, 1974-93, in relation to the total allowable catch (upper pannel), and estimated commercial catch rates for inshore and offshore fishing zones (kg/person-week fished, lower pannel). Vertical lines represent ± one standard error about the mean.

APPENDIX 1, ARCTIC CHARR CATCH STATISTICS, 1974-1993.
SUMMARY OF CATCH AND EFFORT DATA FOR THE MAIN FISHING REGION

AREA=ANTONS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS						19371	8460	7870	6191	23062
CATCH (KG)	9135	3489	3172	2111	4011	63	32	38	24	63
EFFORT (PERSON-WKS)	34	20	6	20	17	307	264	207	258	366
C/E (KG)	269	174	529	106	236	22	14	13	12	9
% > 2.3 KG			21	24	28					
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS						11019	12659	2813	413	1904
CATCH (KG)	13099	14212	13589	8611	8460	32	45	20	6	11
EFFORT (PERSON-WKS)	82	51	67	55	29	344	281	141	69	173
C/E (KG)	160	279	203	157	292					
% > 2.3 KG	7									

AREA=VOISEY BAY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS						22500	22500	16100	16100	16000
CATCH (KG)	20045	238	12232	22488	33597	21880	11557	16325	7688	2953
EFFORT (PERSON-WKS)	64	2	45	56	85	59	52	53	38	17
C/E (KG)	313	119	272	402	395	371	222	308	202	174
% > 2.3 KG			42	35	34	32	17	16	17	17
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS	16000	23400					7236	8158	8851	6558
CATCH (KG)	8113	1435	3065	12630	5577		24	43	36	38
EFFORT (PERSON-WKS)	24	6	22	54	26		301	190	246	173
C/E (KG)	338	239	139	234	215					
% > 2.3 KG	16									

AREA=ANAKTALIK BAY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS						21500	21500	8660	8660	11000
CATCH (KG)	7821	2548	14670	21604	13075	14913	8045	9157	10836	2359
EFFORT (PERSON-WKS)	28	10	45	63	55	76	53	32	27	24
C/E (KG)	279	255	326	343	238	196	152	286	401	98
% > 2.3 KG			36	38	27	20	12	10	11	11
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS	6100	8400		5000	5000	5000	5000	5000	5000	5000
CATCH (KG)	1980	7477	180	2002	1075	1175	454	1484	70	230
EFFORT (PERSON-WKS)	34	39	7	18	12	13	5	17	3	6
C/E (KG)	117	192	26	111	90	90	91	87	23	38
% > 2.3 KG	12									

APPENDIX 1. ARCTIC CHARR CATCH STATISTICS, 1974-1993.
SUMMARY OF CATCH AND EFFORT DATA FOR THE MAIN FISHING REGION

AREA=DOG ISLAND

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS										6858
CATCH (KG)	2659	653	212	2039	386	1440	3048	1516	1105	62
EFFORT (PERSON-WKS)	38	40	11	49	25	61	86	37	38	111
C/E (KG)	70	16	19	42	15	24	35	41	29	8
% > 2.3 KG			11	9	8	15	11	14	7	
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)	6666	6882	3289	16881	11735	2794	7219	1240	2134	2218
EFFORT (PERSON-WKS)	66	62	32	86	88	27	44	14	16	18
C/E (KG)	101	111	103	196	133	103	164	89	133	123
% > 2.3 KG	10									

AREA=NAIN BAY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS										5000
CATCH (KG)	12461		3119	8464				5450	85	532
EFFORT (PERSON-WKS)	37		10	28				29	1	8
C/E (KG)	337		312	302				188	85	67
% > 2.3 KG			16	15				4		2
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)	1886	2667	6437	3806	5179	20734	10265	4039	4762	2346
EFFORT (PERSON-WKS)	15	32	39	15	33	61	61	59	45	33
C/E (KG)	126	83	165	254	157	340	168	68	106	71
% > 2.3 KG	6									

AREA=TIKKOATOKAK BAY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS						39500	39500	28500	35000	35000
CATCH (KG)	9960	27695	31568	39483	55061	37919	42131	28066	28283	16211
EFFORT (PERSON-WKS)	28	76	81	94	147	108	130	80	75	65
C/E (KG)	356	364	390	420	374	351	324	351	377	249
% > 2.3 KG			19	20	18	14	10	5	7	8
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS	26000	12500		16000	16000	16000	16000	16000	16000	16000
CATCH (KG)	8618	6243	3841	3608	2240	2636	1491	2296	2560	2088
EFFORT (PERSON-WKS)	43	24	16	12	12	13	12	16	9	15
C/E (KG)	200	260	240	301	187	203	124	143	284	139
% > 2.3 KG	5									

APPENDIX 1. ARCTIC CHARR CATCH STATISTICS, 1974-1993.
SUMMARY OF CATCH AND EFFORT DATA FOR THE MAIN FISHING REGION

AREA=WEBB BAY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS								8100	4607	15055
CATCH (KG)	580	833	4550	2516	3472	3035	3008	29	27	56
EFFORT (PERSON-WKS)	1	5	15	21	16	9	8	279	171	269
C/E (KG)	580	167	303	120	217	337	376	27	11	5
% > 2.3 KG			21	19	20	39	39			
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS				9000	9000	9000	9000	9000	9000	9000
CATCH (KG)	10476	5143	5890	8424	6041	5904	4859	2343	3111	928
EFFORT (PERSON-WKS)	43	35	34	27	33	17	10	10	16	8
C/E (KG)	244	147	173	312	183	347	486	234	194	116
% > 2.3 KG	7									

AREA=BLACK ISLAND

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS										
CATCH (KG)	4264	2101	2725	3389	2966	10632	20051	14413	11602	11028
EFFORT (PERSON-WKS)	60	62	48	65	81	92	130	94	79	87
C/E (KG)	71	34	57	52	37	116	154	153	147	127
% > 2.3 KG			8	10	14	7	6	7	8	4
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)	7913	12750	17458	11151	12024	18222	20987	4490	6917	5601
EFFORT (PERSON-WKS)	62	68	72	50	61	60	65	37	44	41
C/E (KG)	128	188	242	223	197	304	323	121	157	137
% > 2.3 KG	5									

AREA=KIGLAPAITS

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS								21911	8326	20625
CATCH (KG)	5131	1504	6089	5435	12097	17606	16543	99	34	103
EFFORT (PERSON-WKS)	26	32	59	57	103	120	95	221	245	200
C/E (KG)	197	47	103	95	117	147	174	12	16	12
% > 2.3 KG			25	25	34	14	18			
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)	11431	6184	6983	1620	862	2605	1051	1110	653	524
EFFORT (PERSON-WKS)	55	41	55	14	9	22	10	15	4	4
C/E (KG)	208	151	127	116	96	118	105	74	163	131
% > 2.3 KG	9									

APPENDIX 1, ARCTIC CHARR CATCH STATISTICS, 1974-1993.
SUMMARY OF CATCH AND EFFORT DATA FOR THE MAIN FISHING REGION

AREA=TASIUYAK

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS					2280	1837	1137		1060	1259
CATCH (KG)	1467		281		9	11	8		6	7
EFFORT (PERSON-WKS)	15		2		253	167	142		177	180
C/E (KG)	98		141		71	34	14		11	13
% > 2.3 KG			21							

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS					2823	3186	3302	1077	3063	1153
CATCH (KG)	3423	4724	6749	8997	22	23	17	5	13	3
EFFORT (PERSON-WKS)	23	36	26	61	128	139	194	215	236	384
C/E (KG)	149	131	260	147						
% > 2.3 KG	5									

AREA=NUGFORD

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS										15
CATCH (KG)			1970	1374	1148	170	513			1
EFFORT (PERSON-WKS)			15	9	7	2	5			15
C/E (KG)			131	153	164	85	103			
% > 2.3 KG			30	36	32	16	15			

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)										
EFFORT (PERSON-WKS)										
C/E (KG)										
% > 2.3 KG										

AREA=OKAK BAY

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS								27300	27300	21000
CATCH (KG)	34250	2354	17812	27592	36125	26171	17434	11049	9031	30732
EFFORT (PERSON-WKS)	105	15	52	107	104	123	65	46	26	147
C/E (KG)	326	157	343	258	347	213	268	240	347	209
% > 2.3 KG			29	26	18	11	8	10	7	7

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS	27000	27000	27000	26000	22000	26000	26000	26000	26000	26000
CATCH (KG)	13864	24746	20141	15695	12608	14973	12497	4112		
EFFORT (PERSON-WKS)	30	119	91	71	51	84	45	13		
C/E (KG)	462	208	221	221	247	178	278	316		
% > 2.3 KG	2									

APPENDIX 1, ARCTIC CHARR CATCH STATISTICS, 1974-1993.
SUMMARY OF CATCH AND EFFORT DATA FOR THE MAIN FISHING REGION

AREA=CUTTHROAT

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS										
CATCH (KG)	12641	2703	7526	15488	41146	17803	32397	37263	25699	19043
EFFORT (PERSON-WKS)	95	47	103	130	267	161	205	172	164	164
C/E (KG)	133	58	73	119	154	111	158	217	157	116
% > 2.3 KG			17	25	25	12	12	13	15	10

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)	4570	8515	8756	3954	4842	1591	3628	320	180	578
EFFORT (PERSON-WKS)	65	106	89	70	89	84	55	18	13	9
C/E (KG)	70	80	98	56	54	19	66	18	14	64
% > 2.3 KG	7									

AREA=NAPARTOK

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS										
CATCH (KG)			28972	28039	8551	2486	752	291	16485	
EFFORT (PERSON-WKS)			124	126	50	33	11	1	60	
C/E (KG)			234	223	171	75	68	97	275	
% > 2.3 KG			14	22	20	16	13	12	8	

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS								242	4414	
CATCH (KG)								4	16	
EFFORT (PERSON-WKS)								60	276	
C/E (KG)										
% > 2.3 KG										

AREA=HEBRON FIORD

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS									29072	
CATCH (KG)				5957			2915	39901	37822	
EFFORT (PERSON-WKS)				37				106	98	
C/E (KG)				161				376	386	
% > 2.3 KG				16			19	34	23	

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS	20000				543		643	20731	21252	5608
CATCH (KG)	19531				6		1	49	92	34
EFFORT (PERSON-WKS)	112				91		643	423	231	165
C/E (KG)	174									
% > 2.3 KG										

APPENDIX 1. ARCTIC CHARR CATCH STATISTICS, 1974-1993.
SUMMARY OF CATCH AND EFFORT DATA FOR THE MAIN FISHING REGION

AREA=DOMES

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS								5187	2643	
CATCH (KG)								19	14	
EFFORT (PERSON-WKS)								273	189	
C/E (KG)								36	17	
% > 2.3 KG										

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)	976									
EFFORT (PERSON-WKS)	10									
C/E (KG)	98									
% > 2.3 KG										

AREA=SAGLEK FIORD

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS								24722	23791	
CATCH (KG)								77	118	
EFFORT (PERSON-WKS)								321	202	
C/E (KG)								18	7	
% > 2.3 KG										

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										3247
CATCH (KG)	5389									4
EFFORT (PERSON-WKS)	40									812
C/E (KG)	135									
% > 2.3 KG										

AREA=RAMAH

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS									7758	
CATCH (KG)									26	
EFFORT (PERSON-WKS)									298	
C/E (KG)									20	
% > 2.3 KG										

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS									172	580
CATCH (KG)	3110								2	2
EFFORT (PERSON-WKS)	25								86	290
C/E (KG)	124									
% > 2.3 KG										

APPENDIX 1. ARCTIC CHARR CATCH STATISTICS, 1974-1993.
SUMMARY OF CATCH AND EFFORT DATA FOR THE MAIN FISHING REGION

AREA=NACHVAK

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
QUOTAS										
CATCH (KG)										
EFFORT (PERSON-WKS)										
C/E (KG)										
% > 2.3 KG										

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)		6142	1808							
EFFORT (PERSON-WKS)		18	4							
C/E (KG)		341	452							
% > 2.3 KG										

AREA=MAIN FISHERY

	1974	1975	1976	1977*	1978	1979	1980	1981	1982	1983
QUOTAS										
CATCH (KG)	120414	44118	134898	186165	213915	175263	167991	231221	203012	149732
EFFORT (PERSON-WKS)	531	309	616	863	966	918	880	914	856	804
C/E (KG)	227	143	219	216	221	191	191	253	237	186
% > 2.3 KG			24	25	25	17	12	16	13	8

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUOTAS										
CATCH (KG)	123045	107120	98186	97379	74010	84837	86292	54455	50553	33562
EFFORT (PERSON-WKS)	729	637	554	533	471	436	394	320	315	226
C/E (KG)	169	168	180	183	157	195	219	170	186	149
% > 2.3 KG	6									

* Includes 186 Kg unaccounted for by area